NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 9, 2020

Group Chairman's Factual Report

OPERATIONAL FACTORS

DCA16LA100

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A. ACCIDENT

Operator:	Trans States Airlines (TSA)
Location:	St. Louis, Missouri
Date:	February 23, 2016
Time:	2325 Central Standard Time[1]
Airplane:	Embraer EMB-145-MP[2], N856HK

B. OPERATIONAL FACTORS GROUP

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C. SUMMARY

On February 23, 2016, about 2325 central standard time, Trans States flight 4615, an Embraer EMB-145, N856HK, encountered strong gusting cross winds during its initial approach into Lambert-St. Louis International Airport (KSTL), St. Louis, Missouri, and the flight crew conducted a go around followed by an uneventful landing on the second approach. During post flight inspection, the flight crew found damage to both wing tips. The airplane was substantially damaged and there were no injuries to the 33 passengers and crew members onboard. The flight was operating under the provisions of 14 Code of Federal Regulations Part 121 as a scheduled domestic passenger flight from Chicago O'Hare International Airport (KORD), Chicago, Illinois, to KSTL.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board (NTSB) investigators on the Operational Factors Group were assigned to the accident on Thursday, February 25, 2016 and did not travel to the accident scene. The group chairman was briefed by the Investigator in Charge (IIC) on the events surrounding the accident.

On Friday, February 26, 2016, the Operation Group was formed with party members from the FAA, Trans States Airlines (Operator), and the Airline Pilots Association (ALPA). The

[1] All times are Central Standard Time (CST) based on a 24-hour clock, unless otherwise noted. At the time of the accident local time was UTC -6 hours.
[2] Embraer S.A. EMB-135ER, EMB-135LR, EMB-135KE, EMB-135KL, EMB-135BJ, EMB-145, EMB-145ER, EMB-145MR, EMB-145LR, EMB-145XR, EMB-145MP, EMB-145EP Source FAA Order 8900.1 Figure 5-88

investigation team conducted a teleconference call discussing various aspects that the investigation was preliminary planning to undertake. The Operations Group chairman participated in that teleconference and requested, from the operator, manuals and other various items for the investigation. In addition, they notified the operator the Operations Group will be interviewing the flight crew and possibly the dispatcher, flight attendant, and other company personnel.

On Thursday, March 3, 2016, the Operations Group interviewed both the event first officer and event captain, via separate conference calls. Flight documents and company manuals were obtained from TSA.

E. FACTUAL INFORMATION

1.0 History of Flight[3]

The flight crew reported for duty on the day of the accident at 1405 eastern standard time (EST) at Louisville International Airport – Standiford Field (SDF), Louisville, Kentucky. The duty day for the flightcrew consisted of a deadhead[4] flight from SDF to Washington-Dulles International Airport (IAD), Washington, D.C. The crew operated the subsequent flights from IAD to Henry Ford International Airport (GRR), Grand Rapids, Michigan and then from GRR to ORD. Their day concluded with the accident flight from ORD to STL with a scheduled arrival time of 2347[5].

The first officer performed the preflight of the aircraft prior to departure from ORD. There was no damage noted on either of the wingtips or the ailerons. The passengers were boarded, preflight checklist items were completed, and the flight departed the gate 2225.[6] The first officer was the pilot flying. There was no turbulence expected along the route of flight and the captain released the flight attendant to perform cabin duties during the climbout.

After receiving the STL ATIS[7], via the airplane's ACARS[8], the first officer briefed the approach to runway 30R and queried the captain about using flaps 22 instead of flaps 45. The anticipated approach speed for a 38,000-pound landing, including the add on factor for the crosswind, was within structural limits for flaps 45 and a flaps 45 landing was briefed. According to the captain the approach speed for their weight was 121 knots plus 10 knots for one-half the gust factor for a planned approach speed of 131 knots[9].

The accident flight contacted the STL air traffic control tower (ATCT) about 15 to 20 miles from the airport. The ATCT offered, and the crew accepted, the visual approach to runway 30L. The flightcrew briefed the approach to 30L and verified their approach speed with the wind corrections. During the approach between 1,300 feet and 1,700 feet above ground level (agl) the

[3] Source: Attachment 1 - Flight Crew Interview Summaries and Statements
[4] Deadhead is a term used to describe crewmembers being repositioned while seated in the passenger cabin and are considered on duty but not operating the flight
[5] Actual recorded arrival time (at gate) was 2334. Source: Attachment 3 - Flight Crew Schedules.
[6] The original departure time was 2230. Source: Attachment 3 – Flight Crew Schedules.
[7] Automated Terminal Information Service
[8] Aircraft Communication and Report System
[9] Source: Attachment 1 – Flight Crew Interview Summaries and Statements pg. 12.

airspeed was noted as fluctuating plus or minus 5 knots. Below 1,000 feet agl the airspeed stabilized. The first officer had hand flown the airplane utilizing the flight director from approximately 10,000 ft[10]. During the approach the captain provided the first officer with a verbal cue to reduce the thrust. About 100 feet agl the first officer began performing a side slip to correct for the wind drift and about 20 feet agl he reduced the engine thrust to idle. Utilizing full right aileron and full left rudder inputs, the airplane continued to drift to the left of the runway centerline. About 10 feet agl a go around was announced by the first officer and he applied max thrust. The captain retarded the throttles to flight idle, and subsequently advanced the thrust levers back to the max thrust position. A warning chime was audible to the flightcrew. However, neither crew member could recall what caused the warning once the airplane was climbing out, as no warning message was on the EICAS[11]. The flap lever was moved to the flaps 9 detent and the gear was retracted after a positive rate of climb was confirmed.

After the go-around and about 1,000 feet agl, the normal climb sequence was continued. The first officer transferred control of the airplane to the captain. The flight remained in a left traffic pattern for the visual to runway 30L. The captain briefed the use of flaps 22 for the visual approach to runway 30L and the first officer conducted the required checklist items. The airplane landed on 30L about 15 minutes after the go-around had begun.

After landing, the airplane taxied to the assigned gate and the passengers were deplaned. The first officer conducted a postflight inspection at which time damage to both wings was observed.

A passenger seated on the accident flight reported, in part, "*Upon approach to land…something was horribly wrong as the plane started swaying heavily from side to side…the left wing tip slammed onto the ground spraying sparks and then the plane swayed and tipped onto the right wing where the plane wing hit the ground spraying sparks…the pilot took the aircraft back into the sky…we were able to circle back around and the pilot did an excellent job of bringing the plane safely back down to the ground the second time around.*"

According to flight data recording information, prior to the gear weight on wheels activation, the airplane was rolling up to 15 degrees left and right. Following the weight on wheels indication, which was about 1 second in duration, the engines thrust lever angle was advanced from about 20 degrees to near 90 degrees. Subsequently the thrust lever angles indicated a reduction to 20 degrees for about 1 second and then advanced again to near 90 degrees. This data corresponds to the crew's statement that after the first officer advanced the thrust levers the captain retarded the thrust levers and then advanced them again.

2.0 Flight Crew Information

The accident flightcrew consisted of 2 pilots and 1 cabin crew member. The captain was the pilot monitoring (PM) on the accident flight and the first officer (FO) was the pilot flying (PF).

[10] Source: DCA16LA100 – Attachment 1 Tabular; frame H165414.
[11] Engine Indicating and Crew Alerting System

The crew reported on the first day of the 4-day trip with a report for duty time at 0736. The 4-day trip consisted of 13 operating legs and 1 deadhead leg, which occurred on the day of the accident. The day of the accident the crew reported for duty at 1405 as SDF.

2.1 Captain

The captain was 59 years old and held an Airline Transport Pilot (ATP) certificate with a rating for airplane multiengine land and type ratings on the ATR-42[12], ATR-72, BA-4100[13], EMB-145, EMB-120[14], SA-227[15], SF-340[16]; Commercial Privileges; Airplane Single-Engine Land certificate was issued on November 4, 2002.

The captain held a FAA first class medical certificate issued December 3, 2015 with the limitation that he must wear corrective lenses and possess glasses for near and intermediate vision. The captain stated during an interview that he was wearing his lineless bi-focal lenses at the time of the accident.

According to FAA records the captain had no prior accidents, incidents, or violations. The captain stated he had failed a type rating checkride for the ATR72 in 1996. The captain further stated that he had conducted go-arounds before, but the accident flight's go-around was the lowest he had ever conducted one.

The captain stated that he was not a reserve pilot and the accident trip was a regular bid trip. Prior to the accident trip he had not flown with the first officer. The captain was current and qualified under Trans States Airlines and FAA requirements. A review of FAA EIS[17] records found that there was no enforcement action noted.

2.1.1 The Captain's Pilot Certification Record

FAA records of the captain indicated the following:

Private Pilot – Airplane Single-Engine Land certificate was issued on September 21, 1981, on the basis of United Kingdom Pilot License.

Commercial Pilot – Airplane Single-Engine and Multiengine Land, Instrument – Airplane certificate was issued on November 10, 1981.

Flight Instructor – Airplane Single-Engine certificate was issued on December 10, 1981.

Flight Instructor – Airplane Single-Engine, Instrument-Airplane certificate was issued on December 10, 1981. Renewed December 21, 1983.

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[12] Aérospatiale/Aeritalia, France ATR-42, ATR-72 Source FAA Order 8900.1 Figure 5-88.
[13] British Aerospace Corporation Jetstream 4100 Source: FAA Order 8900.1 Figure 5-88.
[14] Embraer S.A. EMB-120, EMB-120RT, EMB-120ER, EMB120FC, EMB-120QC Source FAA Order 8900.1 Figure 5-88.
[15] M7 Aerospace LLC SA-226-TC, SA227-AC, SA227-AT, SA227-BC, SA227-CC, SA227-DC, SA227PC, SA227-TT Source FAA Order 8900.1 Figure 5-88.
[16] SAAB-Fairchild International, S-58188 Linkoping, Sweden SAAB-Fairchild 340 Source FAA Order 8900.1 Figure 5-88.
[17] Enforcement Information System

Airline Transport Pilot – Airplane Multiengine Land; Commercial Privileges, Airplane Single-Engine Land certificate was issued on November 19, 1984.

Airline Transport Pilot – Airplane Multiengine Land; SA-227; Commercial Privileges Airplane Single-Engine Land certificate was issued on June 19, 1986.

Airline Transport Pilot – Airplane Multiengine Land; SA-227, SF-340; Commercial Privileges Airplane Single-Engine Land certificate was issued on August 1, 1986.

Airline Transport Pilot – Airplane Multiengine Land; SA-227, EMB-120, SF-340; Commercial Privileges Airplane Single-Engine Land certificate was issued on November 18, 1988.

Airline Transport Pilot – Airplane Multiengine Land; SA-227, SF-340, EMB-120, BA-4100; Commercial Privileges Airplane Single-Engine Land certificate was issued on September 2, 1995.

Notice of Disapproval – Airline Transport Pilot Multiengine Land Airplane ATR-42 was issued on December 5, 1996. Unsatisfactory items: 0 flap approach, Circle to land. Items not checked: Instrument Takeoff, Rejected Takeoff.

Airline Transport Pilot – Airplane Multiengine Land; SA-227, SF-340, EMB-120, BA-4100, ATR-42, ATR-72 was issued on December 16, 1996.

Airline Transport Pilot – Airplane Multiengine Land; ATR-42, AT-72, BA-4100, EMB-145, EMB-120, SA-227, SF-340; Commercial Privileges; Airplane Single-Engine Land certificate was issued on November 4, 2002.

2.1.2 The Captain's Pilot Certificates and Ratings Held at Time of the Accident

Airline Transport Pilot (issued November 19, 1984)
Airplane Multiengine Land
Type ratings in the ATR-42, ATR-72, BA-4100, EMB-120, EMB-145, SA-227, and SF-340

Commercial Pilot (issued November 10, 1981)
Airplane Single-Engine Land

Flight Instructor (issued December 10, 1981)
Airplane Single-Engine Land
Instrument – Airplane

Medical Certificate – First Class (issued December 3, 2015)
Limitations: Must wear corrective lenses and possess glasses for near and intermediate vision

Private Pilot (Foreign Based) (issued September 21, 1981)
Airplane Single-Engine Land

Limitations: Issued on the basis of and valid only when accompanied by United Kingdom pilot license. Not Valid for agricultural aircraft operations.

2.1.3 Captain's Training and Proficiency Checks Completed

A synopsis of the captain's recent training at TSA is as follows[18]:

Date of Hire	February 1, 1991
Line Oriented Flight Evaluation (LOE)	February 16, 2016
AQP Maneuvers Validation (AQPMV)	February 15, 2016
Most Recent Line Check (CQLC)	November 5, 2015
Recurrent Crew Resource Management (RCRM)	September 18, 2012
Recurrent Windshear Training (RSWIND)	March 27, 2013
FMS Difference Training (DIFFTRN4)	April 4, 2015
iPad Training (IPAD)	May 28, 2015
Differences Training EM3 (DIFFTRNG)	April 4, 2015
Emergency Drills Hands on Training (AQPHON)	April 1, 2015
FAR 117 Rest and Duty (FAR117)	November 14, 2013
Constant Descent Final Approach Training (CDFA)	October 10, 2013

2.1.4 Captain's Flight Times

The Captain's flight times based on TSA provided documentation:

Total Flying Experience	30,406.1 hours
Total Pilot-In-Command (PIC) experience	16,952.8 hours
Total EMB 145 flying experience	12,223.3 hours
Total EMB 145 PIC flying experience	12,223.3 hours
Total flying time preceding 24 hours	3:39 hours
Total flying time preceding 7 days	16:53 hours
Total flying time preceding 30 days	63.8 hours
Total flying time preceding 90 days	168.3 hours

2.2 First Officer

The First Officer (FO) was 24 years old; held an ATP certificate with type ratings on the CA-212 and EMB-145 limitations included "ATP/EMB-145 Circle Approach. - VMC[19] ONLY; CA-212 SIC Privileges Only; EMB-145 is subject to PIC Limitations." He held an FAA first-class medical certificate dated June 13, 2015, with limitations of "Must wear corrective lenses." He further reported that he was wearing glasses at the time of the accident.

[18] Source: Attachment 2 – Flight Crew Training Records.
[19] Visual Meteorological Conditions

The FO had been continuously employed at TSA since his date of hire and had been a first officer on the EMB-145 the entire time. He had no other duties at TSA. He estimated he had approximately 1,850 hours of total flight experience, of which approximately 320 of those hours were on the EMB-145. Additionally, he had been a line pilot for the previous two months.

Prior to Trans States Airlines, the FO was employed as a pilot for Ryan Air in Alaska, from June 2014 until June 2015. Prior to that he was a flight instructor near Chicago, Illinois.

The FO stated that he had conducted low-level go-arounds at least two times during training, which was typically conducted at 50 feet agl. He had conducted about 4 go-around maneuvers in the past, however none of them were in the EMB-145.

The FO stated that the company limit and his personal crosswind limit was 30 knots.

A review of the FAA EIS data base revealed no accidents or incidents.

2.2.1 First Officer's Pilot Certification Record

FAA records for the first officer indicated the following:

Notice of Disapproval – Private Pilot Single-Engine Land Airplane was issued on March 6, 2011. Areas for reexamination: Takeoffs, Landings, and Go Arounds, Navigation. Comments: ADM[20]-Pilot continued VFR[21] at 1000 [feet] agl[22] with simulated deteriorating weather. Asked time to destination. Gave estimate and explained how he would avoid the 2000' tower 1 mile off his route. Cross controlled on final – wind 090@7 and RW2. Overshot final slightly, rolled level with full right rudder and left aileron. Asked to explain, said that due to overshoot, needed to maintain runway alignment. Holds full aileron deflection on crosswind takeoff until off ground. Held left rudder climbing out with right cross wind twice and also on a go around.

Private Pilot – Airplane Single-Engine Land; English Proficient certificate was issued March 10, 2011.

Private Pilot – Airplane Single-Engine Land; Airplane Multiengine Land; English Proficient certificate was issued August 21, 2011.

Private Pilot – Airplane Single-Engine Land; Airplane Multiengine Land; Instrument-Airplane; English Proficient certificate was issued on April 12, 2012.

Commercial Pilot – Airplane Multiengine Land; Instrument Airplane; Private Pilot Privileges; Airplane Single-Engine Land; English Proficient certificate was issued April 22, 2013.

Commercial Pilot – Airplane Single-Engine Land; Multiengine Land; Instrument Airplane; English Proficient certificate was issued on May 12, 2013.

[20] Aeronautical Decision Making
[21] Visual Flight Rules
[22] Above Ground Level

Flight Instructor – Airplane Single-Engine certificate was issued on August 24, 2013.

Flight Instructor – Airplane Multiengine; Airplane Single-Engine certificate was issued on October 27, 2013. Renewed on October 1, 2015.

Commercial Pilot – Airplane Multiengine Land; Airplane Single-Engine Land; Instrument Airport, CA-212[23] SIC[24] Privileges Only; English Proficient certificate was issued on March 5, 2015.

Airline Transport Pilot – Airplane Multiengine Land; EMB-145; CA-212; Commercial Privileges Airplane Single-Engine Land; ATP/EMB-145 Circle Approach – VMC[25] Only; CA-212 SIC Privileges Only; EMB-145 is subject to PIC Limitations certificate was issued on August 18, 2015.

2.2.2 The First Officer's Pilot Certificates and Ratings Held at Time of the Accident

Airline Transport Pilot (issued August 18, 2015)
Airplane Multiengine Land
Type ratings in the EMB-145 and CA-212

Commercial Pilot (issued May 12, 2013)
Airplane Single-Engine Land

Flight Instructor (issued October 27, 2013)
Airplane Single-Engine and Multiengine

2.2.3 First Officer's Training and Proficiency Checks

A synopsis of the FO's recent training at TSA was as follows[26]:

Date of Hire	June 15, 2015
Initial Basic Indoc (IBI)	July 1, 2015
Initial Proficiency Check (IPC100)	August 18, 2015
Initial Operating Experience Jet (IIOEJ)	October 8, 2016
Initial Windshear Training (IWIND)	August 13, 2015
Initial Crew Resource Management (ICRM)	July 13, 2015
AQP Line Check Transition (AQPLC)	January 27, 2016
Initial Line Check (ILC)	October 8, 2015
FMS Difference Training (DIFFTRN4)	September 16, 2015
Electronic Flight Bag (EFB)	June 19, 2015
Differences Training EM3 (DIFFTRNG)	April 26, 2015
FAR 117 Rest and Duty (FAR117)	June 25, 2015
Constant Descent Final Approach Training (CDFA)	August 16, 2015

[23] Constructiones Aeronáuticas S.A. CASA (Model) C-212-CB. Source FAA Order 8900.1 Figure 5-88
[24] Second-in-Command
[25] Visual Meteorological Conditions
[26] Source: Attachment 2 – Flight Crew Training Records.

2.2.4 First Officer's Flight Times

The First Officer's estimated flight times were based on pilot provided information and TSA documentation:

Total pilot flight time	1820:00 hours
Total EMB-145 flight time	320:00 hours
Total PIC experience	654:00 hours
Total flight time preceding 24 hours[27]	3.6 hours
Total flight time preceding 30 days	79.2 hours
Total flight time preceding 90 days	223.4 hours

2.3 Medical and Pathological Information

Toxicology tests were performed by the Quest Diagnostics Laboratory in Lenexa, Kansas on samples from the captain and first officer. Samples from both pilots tested negative for a wide range of drugs, including major drugs of abuse.

3.0 Aircraft Information

Photo 1: Courtesy of JetPhotos.net website

The accident airplane (Registration N856HK, Serial No. 145441) was an Embraer EMB-145MP was powered by two Rolls-Royce Corporation AE3007A1 engines. The engines were rated at 7,426 pounds of takeoff thrust each. Engine indications were displayed on the EICAS display. The airplane was built in 2001, registered to AFS Investments XIV LLC, and leased to Trans States Airlines LLC on May 8, 2013, and held a transport category airworthiness certificate. The airplane was configured with 2 pilot seats, a cockpit observer seat, a flight attendant seat, and 50 passenger seats.

[27] Flight time included the accident flight.

3.1 Weight and Balance

Trans States Airlines was authorized under their Operations Specifications[28] to use actual weights or a combination of actual, standard average (or segmented), or survey-derived average weights. For Domestic operations the standard weights utilized were 184 pounds per passenger in the summer and 189 pounds per passenger in the winter. There was no weight associated with a carry-on or personal item. For checked baggage the weight utilized was 30 pounds and 60 pounds for "heavy" bags. TSA also utilized plane side loaded baggage which utilized 20 pounds per bag. TSA utilized an Electronic Weight & Balance/Performance Program within the FMS to calculate the weight and balance of the aircraft as required prior to every takeoff.[29]

The following weight and balance information was taken from the dispatch flight release and weight data record. Limitations are indicated in **bold** type. All weights below are in pounds (lbs.).

Basic Operating Weight[30]	27,817
Total Payload[31]	5,670
Zero Fuel Weight	33,487
Maximum Zero Fuel Weight	**39,462**
Planned Block Fuel[32]	5,600
Actual Fuel Weight[33]	5,800
Taxi Fuel	400
Ramp Weight	39,287
Maximum Ramp Weight	**46,495**
Takeoff Weight	38,887
Maximum Allowable Takeoff Weight[34]	**44,981**
Planned Fuel Burn	2,432
Planned Landing Weight[35]	38,232
Actual Landing Weight[36]	36,455
Maximum Landing Weight	**42,549**

[28] Per Ops Spec A098 "Medium Cabin Aircraft Passenger and Baggage Weight Program."
[29] Trans States Weight and Balance Manual Rev 9 1-1.1C, Section 1 Page 2
[30] The Aircraft BOW was determined by the maintenance department and included the following weights: Basic Empty Weight of the aircraft (which is the weight of a standard aircraft including unusable fuel, full operating fluids and full oil); Pilot in Command, First Officer; Flight Attendant; Flight Kits, Crew Overnight Bags (one per crewmember); Galley Supplies, Trans States publications; and Misc. Items (magazines, etc.) per Weight and Balance Manual 1-4 "Basic Operating Weights" Section 1 page 11.
[31] Total payload included 30 passengers at 189 lbs. average weight per passenger with the following distribution: 0 in zone A, 10 in zone B, 11 in zone C, 5 in zone D, and 4 in zone E. Additionally there were 26 total bags, 13 standard and 13 valet (planeside loaded) bags.
[32] Minimum fuel for takeoff was listed as 4,832 lbs. with a minimum gate fuel of 5,232 lbs. Source: Attachment 4 – Accident Flight's Dispatch Release.
[33] Source: Attachment 7 – Accident Flight's Weight and Performance Record which recorded 5800 lbs. of fuel on board.
[34] This is based on adding the MLW and the estimated fuel burn. The structural takeoff weight was 46,275.
[35] Planned landing weight was a dispatch estimated weight based on an estimated takeoff weight.
[36] Based on actual takeoff weight minus planned fuel burn.

3.2 Landing Performance

The Trans States Airlines Dispatch Release provided to the accident flight prior to departure, provided minimum landing distances for the flight based on various weather conditions, weights, and flap settings, as well as provided a component for headwinds and tailwinds. The charts for the minimum landing distance for flaps 22 and flaps 45 with normal visibility were:

```
----------- MIN LDG DIST - FLAPS 45 - NORMAL VIS ------------
  LDW   DRY    WET    CS     SN/SL/SW WICE   FAIR   POOR
  4200  4444   4999   4995   6856    10914   4995   6856
  4100  4365   4910   4912   6724    10802   4912   6724
  4000  4286   4821   4829   6592    10690   4829   6592
  3900  4210   4737   4746   6458    10578   4746   6458
/ 3823  4154   4673   4683   6355    10492   4683   6355
  3800  4137   4654   4664   6324    10466   4664   6324
  3700  4063   4570   4581   6190    10354   4581   6190
  3600  3988   4486   4498   6056    10242   4498   6056
HW/KT    -22    -24    -28    -40      -79    -28    -40
TW/KT     70     79     90    131      491     90    131


  ----------- MIN LDG DIST - FLAPS 22 - NORMAL VIS ------------
    LDW   DRY    WET    CS     SN/SL/SW WICE   FAIR   POOR
    4200  5805   6530   5431   8836    13349   5431   8836
    4100  5686   6396   5335   8642    13211   5335   8642
    4000  5567   6262   5240   8447    13073   5240   8447
    3900  5452   6133   5144   8253    12935   5144   8253
  / 3823  5365   6035   5070   8103    12828   5070   8103
    3800  5338   6006   5048   8058    12796   5048   8058
    3700  5226   5880   4952   7864    12658   4952   7864
    3600  5115   5755   4856   7669    12520   4856   7669
  HW/KT    -27    -30    -29    -50      -93    -29    -50
  TW/KT     86     97     94    165      604     94    165
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Figure 1: Minimum Landing Distance Charts

Trans States Airlines Performance and Weight and Balance chart provided minimum required landing length based on the specific runway and weather conditions and was based on a landing weight of 37,100[37]. The minimum runway required lengths that were provided to the crew were:

- Runway 30L at Flaps 45 Minimum required length 4,047 feet
- Runway 30R at Flaps 45 Minimum required length 4,047 feet
- Runway 30L at Flaps 22 Minimum required length 5,210 feet

4.0 Accident Flight Dispatch Release

The accident flight dispatch release was provided to the crew prior to their pushback from the gate in ORD and was listed as “Release 0.” The release was 25 pages in length and contained

[37] Source: Attachment 7 – Accident Flight’s Weight and Performance Records.

route of flight, deferred items, fuel requirements, predicted aircraft performance, weather information such as TAF[38], SIGMETs[39], AIRMETs[40], current weather, and NOTAMs[41].

The only listed maintenance deferral on the aircraft was MEL[42] 25-11-01 which was for an inboard armrest on the captain seat. The MEL further stated that of the 4 armrests in the cockpit 0 were required for dispatching the aircraft. The deferral would not have affected the performance of the aircraft or any other function associated with this accident.

4.1 Weather Briefing

The following weather information, for STL, was included on page 12 of the flight release for the accident flight, and was generated at 0350Z (2150 CST):

KSTL 240251Z 04015G30KT 10SM OVC100 08/M01 A2981 RMK AO2 PK WND 03030/0244 SLP100 T00781011 56015
KSTL 240151Z 02015G27KT 10SM OVC100 08/M01 A2982 RMK AO2 PK WND 02027/0147 SLP104 T00831011
KSTL 240051Z 03018G28KT 10SM FEW075 OVC100 08/M01 A2983 RMK AO2 PK WND 03028/0049 SLP108 T00831011
STL SA NIL
TAF AMD KSTL 240305Z 2403/2506 02018G30KT P6SM OVC090
FM240600 01022G32KT 5SM -RA BR OVC035
FM240900 36025G35KT 1 1/2SM -SN BR OVC012
FM241300 35025G38KT 3/4SM -SN BR OVC007
FM241600 35023G33KT 3SM -SN BR OVC015
FM241900 33022G33KT P6SM OVC025
FM242200 33021G31KT P6SM OVC050

4.2 STL NOTAMs

The dispatch release contained 4 pages of NOTAM information for STL. Of those, the following NOTAMs pertained to runway 30L and runway 6:

STL 12/385 STL RWY 12R/30L SAFETY AREA SIGN BASE ABOVE GRADE SOUTH OF RUNWAY 12R/30L AND EAST OF TWY K 1512310142-1605312359

STL 12/381 STL RWY 12R/30L SAFETY AREA BASE ABOVE GRADE NORTH RWY 12R/30L AND WEST TWY V 1512310139-1605312359

STL 12/380 STL RWY 06/24 SAFETY AREA 2 BASES ABOVE GRADE WEST OF RUNWAY 6/24 AND IN THE RUNWAY 12L APCH PATH 1512310136-1605312359

[38] Terminal Area Forecast
[39] Significant Meteorological Information
[40] Airman's Meteorological Information
[41] Notice to Airman
[42] Minimum Equipment List

STL 12/373 STL RWY 12R/30L SAFETY AREA BASE ABOVE GRADE NORTH OF 30L BLAST PAD 1512310128-1605312359

STL 12/371 STL RWY 12R/30L SAFETY AREA RUTS S RWY 12R/30L AND WEST TWY N 1512310126-1605312359

STL 02/444 STL RWY 30L BAK-14 ARST SYSTEM OUT OF SERVICE 1602232149-1602252359

TAKE-OFF MINIMUMS RWY 6 200-1 OR STANDARD WITH MINIMUM CLIMB OF 286 PER NM TO 800.

NOTE RWY 6 TEMPORARY CRANE 4288 FEET FROM DER 87 FEET RIGHT OF CENTERLINE 160 AGL/687 MSL. 2015-ACE-2841-OE.
ALL OTHER DATA REMAINS AS PUBLISHED. 1510191625-1604161625EST

NOTE RWY 6 TEMPORARY CRANE 4288 FT FROM DER 87 FT RIGHT OF CENTERLINE 120 AGL/649 MSL.
ALL OTHER DATA REMAINS AS PUBLISHED. 1510302021-1604272021EST

4.3 STL PIREP[43]s

The dispatch release contained the following PIREPs on page 15 for STL:

STL UA /OV STL320030/TM 0233/FL060/TP C208/TA 0/IC TRACE-LGT RIME/RM ZKCFD

STL UA /OV STL060070/TM 0138/FL220/TP B737/TB MOD CHOP 220-190/RM ZKC

The reports in plain language taken from standard code and abbreviations, with altitudes in feet above mean sea level (MSL):

St. Louis (STL) VOR[44] routine pilot report (UA); over a point northwest of STL 30 miles; Time 0233Z (2033 CST); Altitude 6,000 feet; Aircraft type - Cessna 208; Temperature 0°C; Icing – Trace to light rime; Remarks - Filed by Kansas City Air Route Traffic Control Center.

St. Louis (STL) VOR routing pilot report (UA); Over a point northeast of STL 70 miles; Time 1938 CST; Altitude – FL220[45]; Aircraft type – Boeing 737; Turbulence – Moderate Chop from FL220 to FL190; Remarks – Filed by Kansas City Air Route Traffic Control Center.

[43] Pilot Reports
[44] Very-high Omnidirectional Range
[45] Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25-hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

5.0 Meteorological Information

The last recorded broadcasted weather, prior to the accident, was the STL METAR[46] which recorded the following ATIS information:

[2251 CST] KSTL 240451Z 03022G27KT 10SM OVC100 07/M02 A2974 RMK AO2 PK WND 36029/0439 SLP075 T00671022

For detailed weather information see the Meteorology Group Chairman's Weather Study Report located in the docket associated with this accident.

6.0 Airport Information

St. Louis-Lambert International Airport (KSTL) was the main commercial airport for the city of St. Louis, Missouri. It is located about 10 miles to the northwest of downtown St. Louis at 38°44:55.31N by 090°22:12.1040W. The airport elevation was 618 feet msl[47]. It covers about 2,800 acres and had four paved landing surfaces. Three of the landing surfaces were oriented in a northwest and southeast direction and one landing surface was oriented in a northeast to southwest direction.

According to FAA records, the airport was owned by the City of St. Louis. The airport had an operating FAA air traffic control tower (ATCT) that operated 24-hours per day and was in operation at the time of the accident.

Remarks associated with the Master Record included load capacity. The load capacity for runways 12L/30R, 12R/30L, and 06/24 all indicated the same capacity.

6.1 Airport Diagram and Notes

[46] Meteorological Aerodrome Reports.
[47] mean sea level

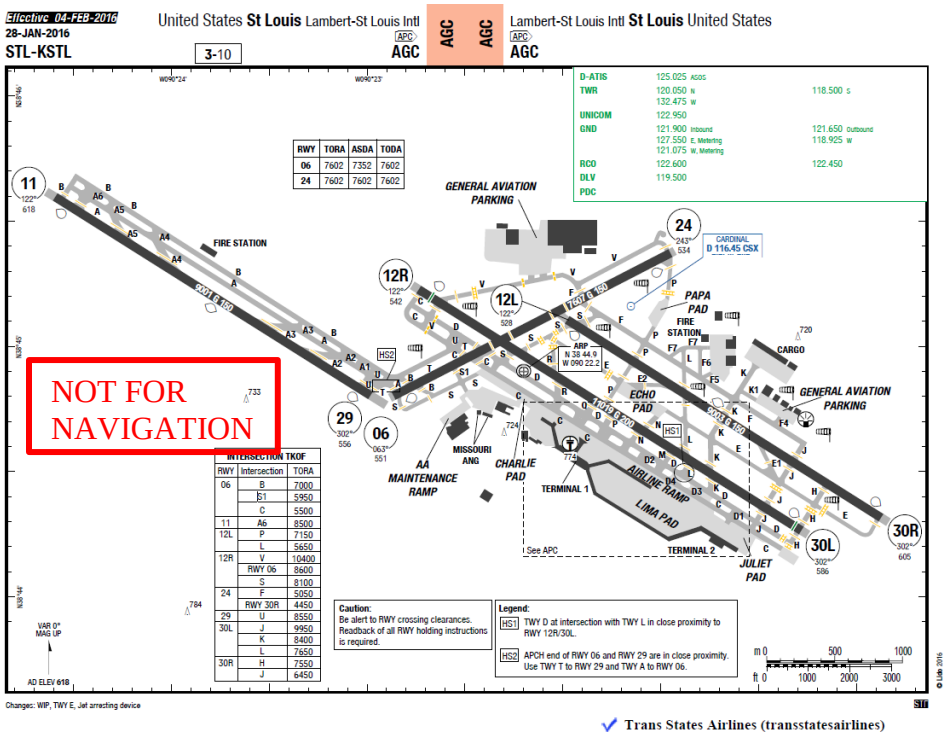


Figure 2: LIDO Chart - Airport Diagram

6.2 Airport Runways[48]

Runway 6/24 was 7,607 feet long and 150 feet wide and was grooved concrete in fair condition. Runway 6 had 7,352 feet available for landing. Runway 6 was equipped with MALSR[49] approach lights and Runway 24 was equipped with MALS[50] approach lights.

Runway 12R/30L was an 11,019-foot-long and 200-foot-wide grooved concrete runway. It was considered to be in good condition. The runway was equipped with MALSR approach lights.

Runway 12L/30R was a 9,003-foot-long and 150-foot-wide grooved concrete runway and considered to be in good condition. The runway was equipped with ALSF2[51] approach lights.

The runway designated as 11/29 was 9,001 feet long and 150 feet wind grooved concrete runway and considered to be in excellent condition. The runway was equipped with ALSF2 approach lights.

Runways were equipped with a 4-light Precision Approach Path Indicator (PAPI) located on the left side of the runway for runways 12R, 24, 29, and on the right of the runway for runways 6, 11, 12L, 30R, 30L, with a charted 3.00-degree visual glide path angle.

[48] Source: FAA Airport Master Record
[49] Medium Approach Light System with Runway Alignment Indicator Lights
[50] Medium Intensity Approach Light System
[51] High Intensity Approach Lighting System with Sequenced Flashing Lights

According to the Aeronautical Information Manual Pilot/Controller Glossary, the precision approach path indicator (PAPI) is an airport lighting facility, similar to VASI, providing vertical approach slope guidance to aircraft during approach to landing. PAPIs consist of a single row of either two or four light, normally installed on the left side of the runway, and have an effective visual range of about 5 miles during the day and up to 20 miles at night. PAPIs radiate a directional pattern of high intensity red and white focused light beams which indicated that pilot in "on path" if the pilot sees an equal number of white lights and red lights, with white to the left of the red; "above path" if the pilot sees more white than red lights; and "below path" if the pilot sees more red than white lights.

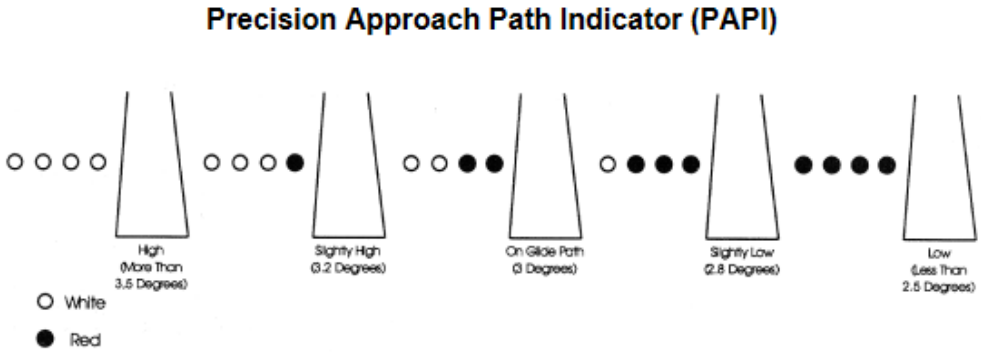


Figure 3: Precision Approach Path Indicator[52]

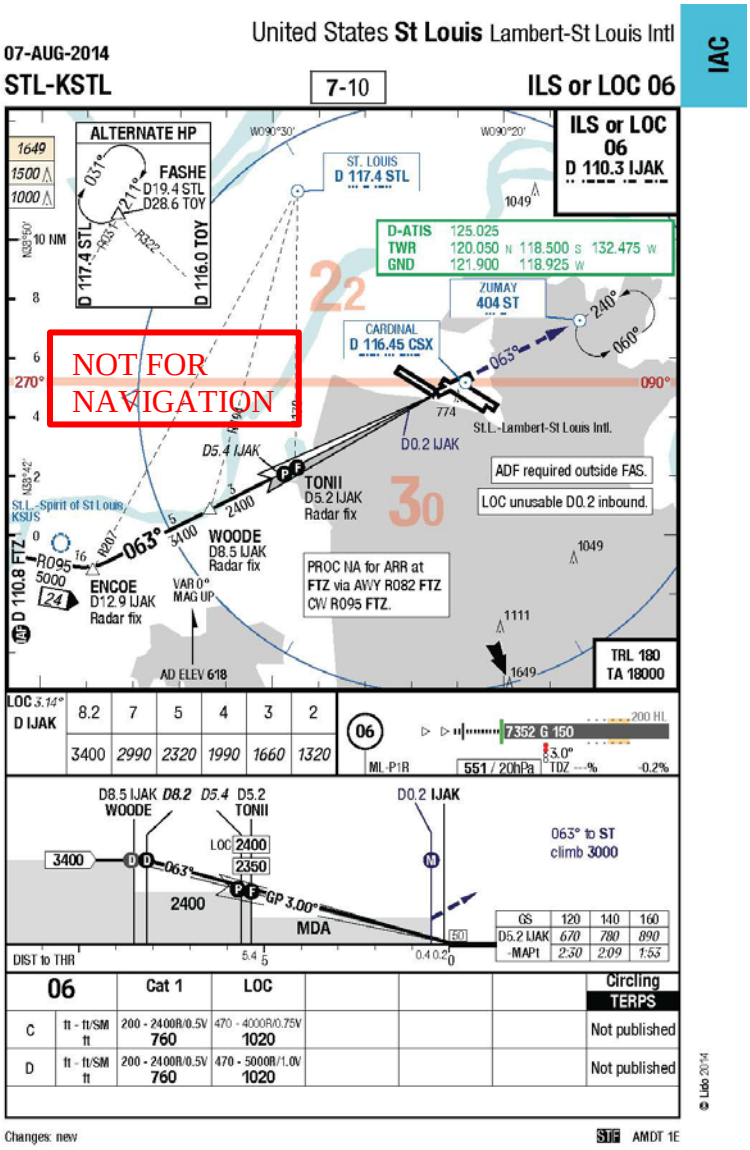
6.3 Charts

At the time of the accident, Trans States utilized LIDO[53] charts. and provided each pilot with a subscription on their electronic flight bag. The following charts were available to the crew at the time of the event. It should be noted that ceiling and visibility was above the required minimum prescribed for the respective approaches below.

[52] Aeronautical Information Manual Chapter 2 Figure 2-1-5

[53] LIDO charts provided navigational information and was produced by German based information technology company, Lufthansa Systems

6.3.1 ILS Runway 6[54]

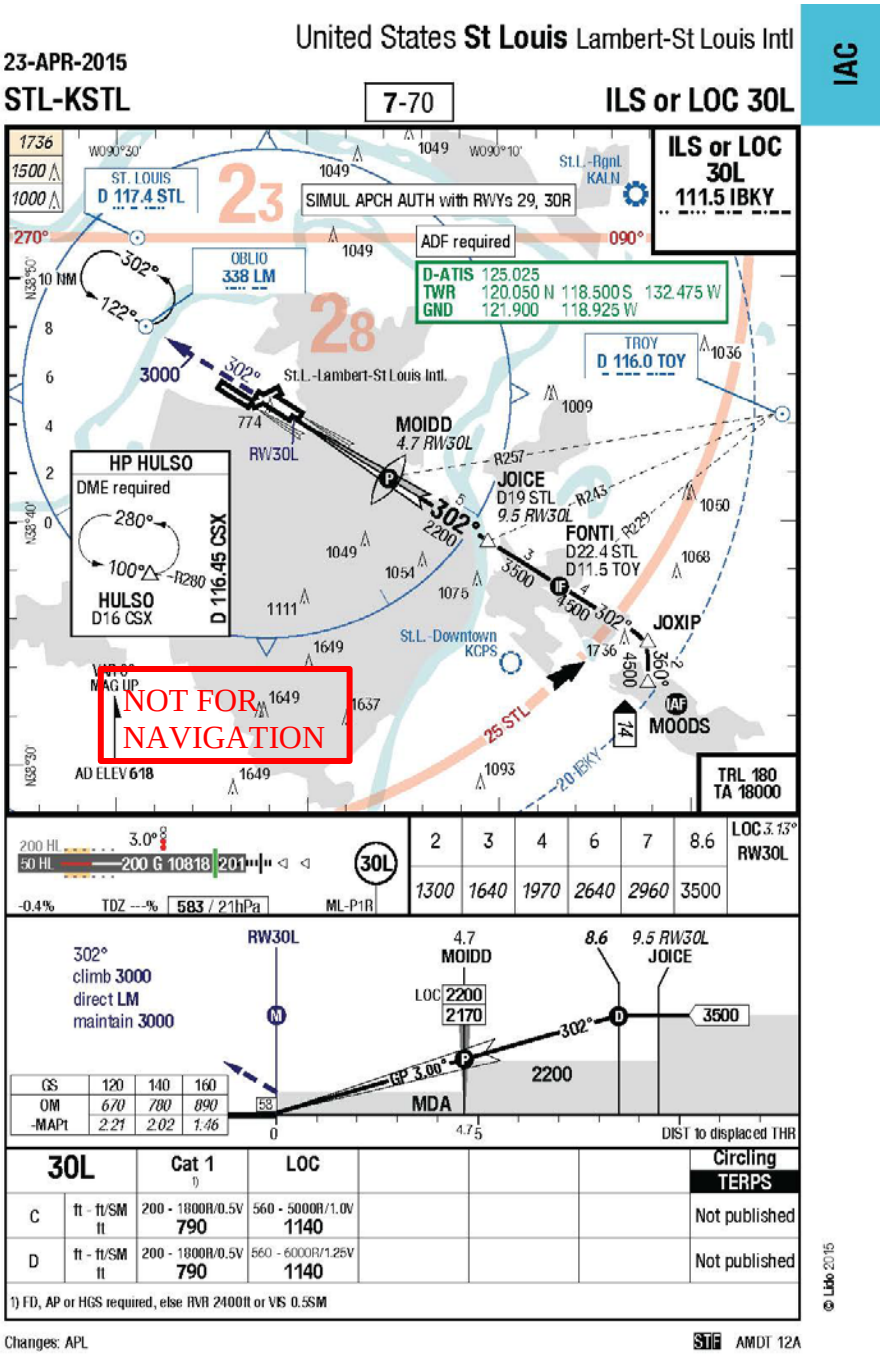


Trans States Airlines (transstatesairlines)

Figure 4: LIDO Chart - ILS or LOC Runway 6

6.3.2 ILS Runway 30L

[54] According to an email from Lufthansa Systems Trans States had the ILS or LOC 06 approach chart available for use beginning in September 2014.



Trans States Airlines (transstatesairlines)

Figure 5: LIDO Chart - ILS or LOC Runway 30L

6.3.3 ILS Runway 30R

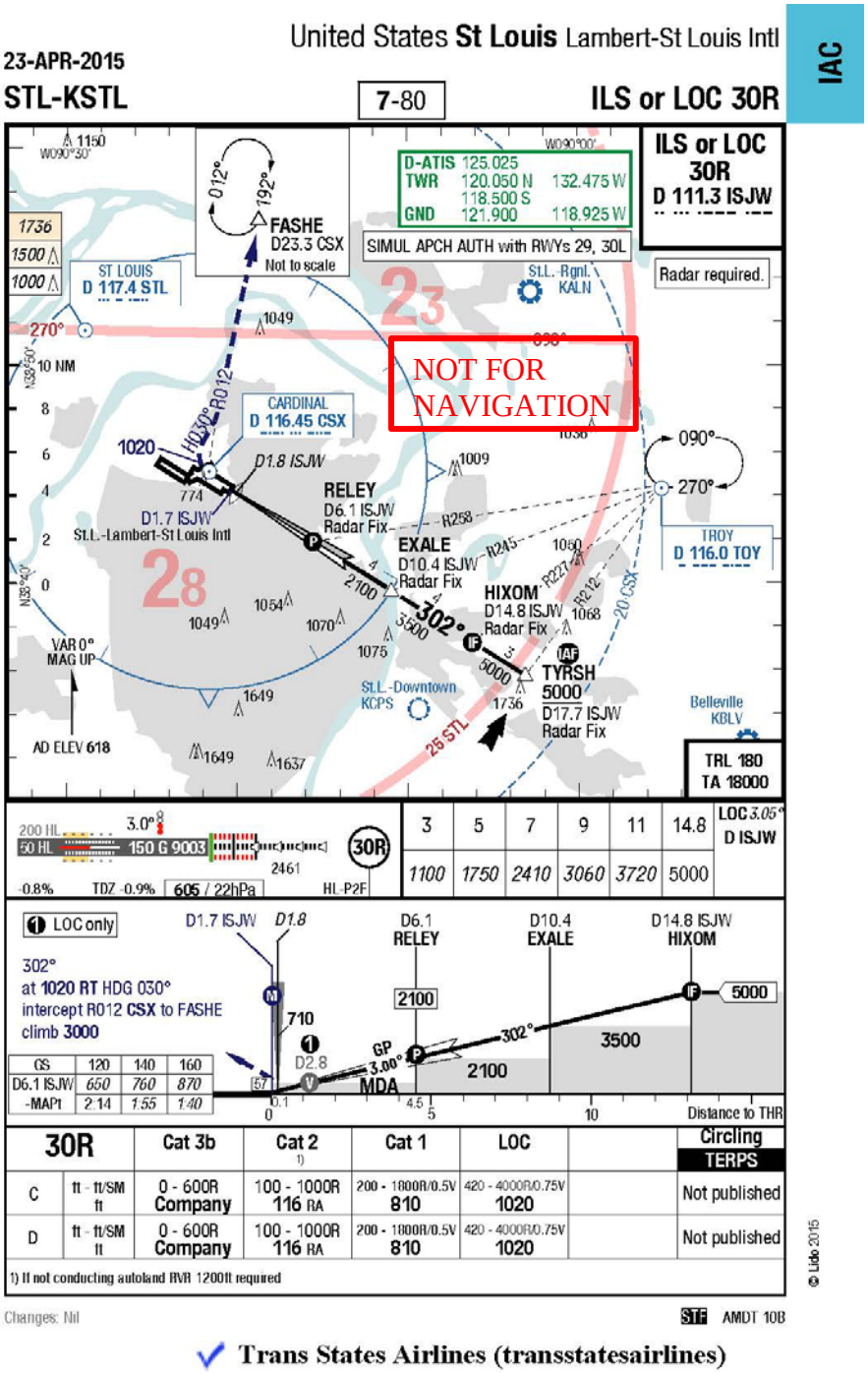


Figure 6: LIDO Chart - ILS or LOC Runway 30R

7.0 Relevant Airplane Systems

The following information has been taken from the Trans States EMB-145 Flight Crew Operations Manual.

7.1.1 Thrust Levers

The TSA EMB-145 Airplane Operations Manual, Section "Thrust Levers" provided the following information about the thrust levers:

> ***1 - GO AROUND BUTTON***
> - *Selects the Go Around mode (Takeoff submode, Go Around Speed Target submode and Windshear mode).*
> - *The button also forces the Flight Director into either the Go Around mode or the Windshear mode, depending on the windshear signal.*

Additionally in the Section "Powerplant" the following information was provided on the thrust lever settings:

> *MAX - Provides maximum takeoff thrust.*
> *THRUST SET - Provides N1TARGET thrust setting.*
> *IDLE - Provides ground and flight idle thrust settings.*
> *MAX REV - Provides maximum reverse thrust.*
>
> ***NOTE**: Protection against inadvertent thrust reverser command in flight is provided through the mechanical idle stop and the electrical flight idle stop.*

7.1.2 Flaps

The TSA EMB-145 Airplane Operations Manual, Section "Flap System Operation" provided the following information about the flap system:

> *The Flap Selector Lever provides five detent settings at 0°, 9°, 18°, 22° and 45° positions. Intermediate positions cannot be selected. When any position is selected, the selector lever signals to the Flap Electronic Control Unit (FECU) to move the flap panels. The FECU also monitors system failures and flap position, sending signals to the EICAS and other related systems.*

7.1.3 Windshear Detection

The TSA EMB-145 Airplane Operations Manual, Section "Crew Awareness" provided the following information about windshear:

> *The windshear detection system is designed to identify the presence of severe windshear phenomenon and to provide timely warnings and adequate flight guidance for approach, missed approach, takeoff and climb out.*
>
> *The windshear computer exchanges data with AHRS, ADC, SPS, Radio Altimeter and IC-600s. The system continuously searches for any windshear clue, and then signals the PFD and aural warning unit to provide the appropriate indications.*

Windshear Caution alerts are given if the windshear consists of an increasing headwind (or decreasing tailwind) and/or severe updraft, which may precede an encounter with a microburst. Windshear cautions activate the Windshear Caution (WDSHEAR) amber indications on the upper left corner of both PFDs. On airplanes equipped with EGPWS, an aural message "CAUTION WINDSHEAR" is also triggered. Windshear Caution indications remain on for as long as the airplane remains exposed to an increasing headwind and/or updraft condition in excess of the alert threshold.

Windshear Warnings are given if the windshear consists of a decreasing headwind (or increasing tailwind) and/or severe downdraft. Windshear warnings activate the Windshear Warning (WDSHEAR) red indication on both PFDs and trigger an aural message "WINDSHEAR, WINDSHEAR, WINDSHEAR". This message will not be repeated unless another, separate, severe windshear event is encountered. Windshear Warning indications remain on for as long as the airplane remains exposed to a decreasing headwind and/or downdraft in excess of the alert threshold. The threshold is adjusted in function of available climb performance, flight path angle, airspeeds significantly different from normal approach speeds and unusual fluctuations in Static Air Temperature (typically associated with the leading edges of microbursts).

WINDSHEAR ESCAPE GUIDANCE MODE

The Windshear Escape Guidance mode is used to minimize altitude and speed loss during a windshear encounter. The strategy is to keep the airplane airborne until the windshear conditions subside or are exited.

The Windshear Escape Guidance Mode provides pitch command to recover from a windshear encounter. The amplitude of the pitch command will depend upon the airplane's performance and windshear severity and phase.

The Windshear Escape Guidance is a Flight Director mode engaged under the following conditions:

- *Manually, by pressing the Go Around Button while a windshear condition (increasing/decreasing performance) is detected;*
- *Automatically, when in Go Around or Takeoff Mode and a windshear condition (increasing/decreasing performance) is detected;*
- *Automatically, when Thrust Levers Angle is above 78° and a decreasing performance windshear is detected (windshear warning).*

When the windshear escape guidance mode is engaged a green "WSHR" indication is displayed on both PFDs in the Vertical Mode field and a "ROLL" indication is displayed in the Lateral Mode field.

Whenever the Windshear Escape Guidance mode is engaged, the Pitch Limit Indicator (PLI) symbol is drawn directly on the Attitude Display Indicator portion of the PFD. The PLI represents the remaining angle of attack margin before Stick Shaker triggering.

All other Flight Director modes are canceled and the following vertical modes are inhibited when a caution or warning windshear condition is presented:

− Altitude Preselect Mode, Go Around and Takeoff. No lateral modes are inhibited while in the vertical mode of WSHR.

The Windshear Escape Guidance mode is designed to meet the following requirements, in the listed order of priorities:

− Prevent the airplane from stalling;
− Prevent the airplane from descending;
− Prevent the airplane from exceeding VMO.

The Windshear Escape Guidance Mode incorporates three control sub-modes:
− Alpha Sub-mode - The airplane can be commanded to descend in order to maintain airspeed when approaching stall conditions. If the flight path angle control results in an angle of attack beyond the stick shaker triggering angle, the windshear control law can keep the airplane angle of attack below the stick shaker threshold.

− Gamma Sub-mode - The airplane can be prevented from descending by commanding a positive flight path angle. A nominal flight path angle is used to allow an airspeed raise during an increasing performance windshear, in anticipation of a decreasing performance windshear, and also to minimize altitude loss during a decreasing performance windshear.

− Speed Target Sub-mode - The airplane is allowed to climb in order to exchange excessive kinetic energy for potential energy. If the control of the flight path angle results in an excessive speed increase, the windshear control law maintains the airplane indicated airspeed at the target speed.

The Windshear Escape Guidance mode will be canceled if any of the following conditions occur:

− FLC, VS, SPD or ALT Mode is selected;
− Invalid AHRS data;
− Invalid ADC data;
− Invalid Stall Protection Computer (SPC);
− Radio Altitude greater than 1500 ft.

7.1.3.1 Primary Flight Display Presentations

The TSA EMB-145 Airplane Operations Manual, Section "Crew Awareness – PFD Presentations" provided, in part, the following information about the windshear annunciation on the PFD:

*When the windshear detection system detects windshear, **WDSHEAR** is displayed to the upper left of the attitude sphere. The annunciator flashes for 10 seconds and then goes on steady. The annunciator is **amber** (caution) if the performance is being increased, and **red***

(warning) if the performance is being decreased. If the go-around button is pushed during a windshear caution or warning, the flight director vertical flight director guidance directs the airplane.

7.1.4 Ground Proximity Warning System

The TSA EMB-145 Airplane Operations Manual, Section "Crew Awareness" provided the following information about the aircrafts ground proximity:

The purpose of the Ground Proximity Warning System (GPWS) is to avoid accidents caused by Controlled Flight Into Terrain (CFIT) and also severe windshear.

The GPWS is based on radio altitude ("look down") information. Some airplanes may be optionally equipped with the Enhanced Ground Proximity Warning System (EGPWS). The EGPWS incorporates GPWS functions with additional features like Terrain Clearance Floor, Terrain Look Ahead Alerting and Terrain Awareness Display. These functions use airplane geographic position, airplane altitude and an internal terrain database to predict potential conflicts between the airplane's flight path and terrain, and to provide graphic displays of the conflicting terrain.

NOTE: *− Unless otherwise indicated, the system description below is applicable to the GPWS and to the EGPWS.*
− Airplanes equipped with EGPWS version 216 and on incorporates additional features like Peaks Mode, Runway Field Clearance Floor, Obstacle Alerting and Geometric Altitude.

The GPWS/EGPWS is a useful navigation aids when flying at low altitude, generally within 2500 ft above terrain. It provides voice messages, EICAS message and PFD indication (EGPWS only) to alert the flight crew, so that they may take appropriate action.

7.1.4.1 EGPWS

The TSA EMB-145 Airplane Operations Manual, Section "Supplementary Procedures Navigation" provided the following information about the Enhanced/Ground Proximity Warning system:

Aural Warning: WHOOP-WHOOP PULL UP or PULL UP (for EGPWS), SINK RATE, TERRAIN TERRAIN or TERRAIN TERRAIN PULL UP (for EGPWS), CAUTION TERRAIN (for EGPWS), OBSTACLE OBSTACLE PULL UP (for EGPWS), CAUTION OBSTACLE (for EGPWS), DON`T SINK DON`T SINK, TOO LOW TERRAIN, TOO LOW GEAR, TOO LOW FLAPS, GLIDE SLOPE and BANK ANGLE voice messages may be generated, but are not associated with GPWS/EGPWS EICAS message.

When an EGPWS/GPWS alert occurs, use the flight controls and thrust as necessary to correct the airplane attitude, flight path and configuration according to the voice message presented to provide terrain clearance.

***CAUTION**: FOR EGPWS, THE TERRAIN DISPLAY IS INTENDED TO BE USED AS A SITUATIONAL TOOL ONLY AND MAY NOT PROVIDE THE ACCURACY AND/OR FIDELITY ON WHICH TO SOLELY BASE TERRAIN AVOIDANCE MANEUVERING DECISIONS.*

7.1.4.2 Bank Angle

The Honeywell EGPWS MK V and MK VII pilots guide provided, in part, the following information on the bank angle callout provided by the EGPWS.

The callout "BANK ANGLE BANK ANGLE" advised of an excessive roll angle.

Additionally, it provided the following graphic which showed that that below 150 feet the required bank angle to activate the alert decreased from 150 feet to 30 feet above ground level, and at 30 feet and below that required bank angle was 10 degrees.

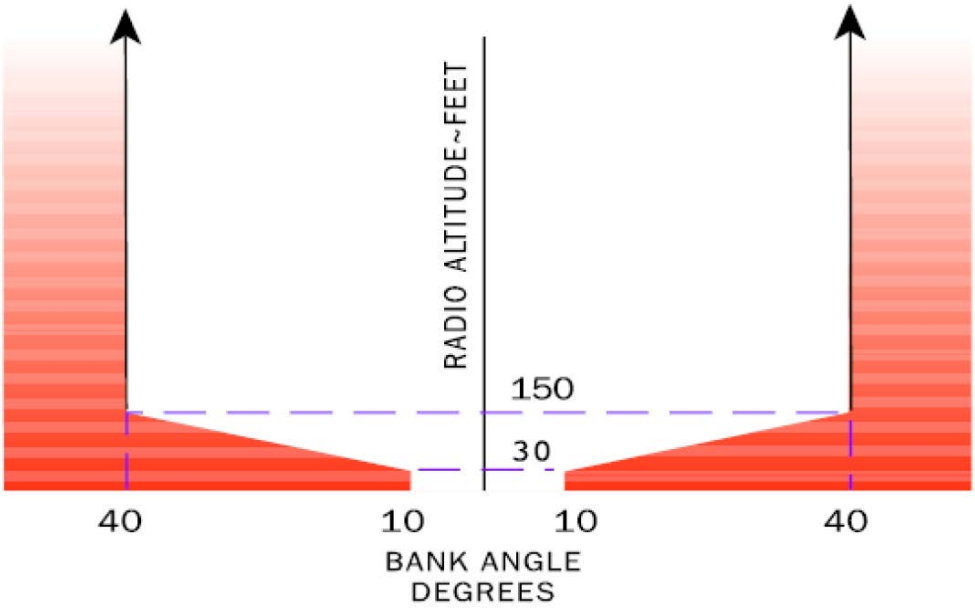


Figure 7: Bank Angle Alert Limits.
(Source: Honeywell MK V and VII Pilots Guide)

7.1.5 Windshear

The Trans States Airlines "EMB-145 Standard Operating Procedures Manual" section 3 "Limitations & Memory Items" provided the following memory item for Windshear Prevention/Recovery:

Thrust Levers…….. MAX
Go-around Buttons…….. PRESS

8.0 Trans States Airline Guidance

8.1.1 Company Procedural Guidance

TSA procedural guidance to crewmembers were located in several manuals. The General Operations Manual (GOM), the Standard Operating Procedures (SOP), the Airplane Flight Manual (AFM), and the Flight Crew Operations Manual (FCOM). The SOP provided operational information of a general nature pertaining to all EMB-145 model aircraft types. The AFM contained specific information, provided from the airplane manufacturer, on the limitations, emergency and abnormal procedures, normal procedures, and performance charts. The Flight Crew Operations Manual (FCOM) provided operational information of a general nature pertaining to all aircraft type. The manuals were available to crewmembers on their assigned electronic flight bag.

8.1 Electronic Flight Bag (EFB)[55]

TSA began utilizing the EFB, iPad Air, as allowed under their Ops Spec A061. The EFB provided electronic access to the company's Electronic Ship Library, along with other written guidance and training materials the company deems necessary for crewmembers. The manuals were always available on the EFB through a company portal application. However, updated documents could only be downloaded to the device when signed into the company portal application while the EFB is connected to Wi-Fi[56]. The EFB completed 7 months of testing, phase I, which concluded October 9, 2015. On October 16, 2015, TSA entered phase II of validation in which the flight crews utilized either the EFB and the LIDO m/Pilot[57] or the Jeppesen manuals and concluded prior to the beginning of phase III. On January 11, 2016, TSA entered phase III. During phase III both the pilot flying (PF) and pilot monitoring (PM) will utilize the LIDO mPilot charting system and the Jeppesen charts will be retained in each pilot's flight kit as a backup to the LIDO mPilot system.

8.1.1 Flight crewmember duties

Title 14 *Code of Federal Regulations* Part 121.542 (d) states "during all flight time as defined in 14 *CFR* 1.1, no flight crewmember may use, nor may any pilot in command permit the use of a personal wireless communications device (as defined in 49 U.S.C. 44732(d)) or laptop computer while at a flight crewmember duty station unless the purpose is directly related to operation of the aircraft, or for emergency safety-related, or employment-related communications, in accordance with air carrier procedures approved by the Administrator."

8.2 Descent Checklist

The TSA EMB-145 Airplane Operations Manual, section “Normal Procedures” provided the following:

Windshield Heating..... ON

[55] Electronic Flight Bag manual, Operation bulletin #1 and #2.
[56] Wi-Fi is a local area wireless computer networking system that allows electronic devices to connect to the internet.
[57] LIDO mPilot provided pilots with navigation charts, documents, and messages on their iPad or EFBs. Source: https://www.lhsystems.com/solutions-services/flight-deck-solutions/lidonavigation/lidompilot

The system must be switched ON to prevent fog and ice formation on the windshield inner layer.

Approach Briefing ..... COMPLETED

The crew must review the descent, approach and landing procedures.

HGS Combiner (if installed)..... SET

If the combiner has been installed, position the combiner in the operating position.

HGS Control Panel (if installed)..... SET

Enter on HCP, the touchdown zone elevation for the landing runway.
Enter on the HCP the glideslope angle for the landing runway.
Select the desired mode.

Speed Bugs ..... SET

Check on the FMS the expected landing weight and set VREF, VAPP, VAPP CLB, VFS on the MFD:
VAPP = VREF + wind correction.
Wind correction = ½ steady headwind component + gust increment above steady wind.
For Flaps 45° landing, the minimum wind correction is 5 KIAS and the maximum is 15 KIAS.
For Flaps 22° landing, the minimum wind correction is 5 KIAS and the maximum is 20 KIAS.
For VAPP CLB, set the VAPP CLB or the VAPP, the greatest.
For VFS, set VFS or the VAPP, the greatest.

EXAMPLE:

- VREF = 118 kts
- Reported wind = 16 kts, gusting to 25 kts
- The wind correction would be ½ (16) + (25 - 16) = 17 kts
However the maximum wind correction is 15 kts (Flaps 45°), thus:
- VAPP = 118 kts + 15 kts = 133 kts descent checklist guidance:

Pressurization .....CHECKED

Verify that the digital controller was set to the destination airport elevation.

BELOW 10000 FT

External Lights ..... ON
The following lights must be turned ON upon crossing 10000 ft:
- LDG1, NOSE AND LDG2.
During night time, the LOGO light must also be turned ON.

Fasten Belts ..... ON

Switch the FASTEN BELTS light upon crossing 10000 ft, if it is not ON yet.
PC Power System (if Installed) ..... OFF

Below 10000 ft the PC Power System must be turned off by pressing the PC Power button on IFE overhead panel.

Curtains.....STOWED

Any curtain used during flight must be stowed for landing.

8.2.1 Approach Briefing

The TSA Standard Operating Procedures Manual. Section 2.22 "In Range Flow – PF" stated the following:

- *Approach Briefing*
  A positive transfer of controls will be made, and the PM will assume PF duties while the briefing is completed.

  The CAT I approach briefing should include:
  1. *Obstructions*
  2. *Threat/Risk considerations*
  3. *Aircraft configuration and speed and planned descent rate (CDFA)*
  4. *Approach title, airport and revision date, navaid frequency*
  5. *Field elevation/minimum sector altitudes*
  6. *Inbound course*
  7. *Initial altitudes, step downs, descent point, minimums (DA(H), DDA)*
  8. *Visibility requirements and reported visibility*
  9. *VDP, as required*
  10. *Missed approach point (MAP)*
  11. *Initial missed approach procedures (immediate action items only, no turns until MAP)*
  12. *For GPS based RNAV approaches (GPS, GNSS), the crew must verify each approach waypoint and the expected holding pattern in the FMS with the Jeppesen approach plate.*
  13. *Taxi-in plan, including planned intersection to exit the runway.*

  Initial approach altitude and procedure turn altitude are not required to be briefed on radar vectored approaches

  Note: *Straight-in minimums are Category C. Circling minimums are Category D. The briefing may be abbreviated if a Visual Approach will be conducted and the reported ceiling is ≥ 3 miles.*

At the completion of the briefing, a positive transfer of controls back to the PF will be made.

8.3 Stabilized Approach

The Trans States Standard Operating Procedures Manual, Section 4.1.S "Stabilized Approach" stated the following:

Flying a stabilized approach has proven to be the safest way to operate the aircraft during the final approach segment of visual and instrument approaches. Advance planning and careful management of the aircrafts energy, course, and descent path during the approach reduces the workload of the crew. Reducing workload during this critical flight segment increases the ability of the crew to recognize and manage threats/errors.

Trans States Airlines defines stabilized approach height for all visual and instrument approaches as follows;

1000 AFE while conducting visual approaches and straight-in instrument approaches in both IMC and VMC weather conditions.

MDA or 1000 AFE (whichever is higher), if a circling maneuver is to be conducted after completing an instrument approach.

During the final approach phase, when operating below stabilized approach height, in both VMC and IMC, on instrument and visual approaches, the following operational parameters must be maintained to consider the approach stabilized. Prolonged deviation from these parameters means the approach has become unstabilized and an immediate missed approach should be initiated. Either the PF or PM may initiate the missed approach utilizing the callout ***"GO AROUND"***

a. *In-Range and Before Landing Checklists not complete.*
b. *Aircraft not properly configured. Final flap setting on circling approaches may be delayed as per EMB SOP Sec 1, 5.9*
c. *Airspeed outside the range:* ***Vref – 5 knots*** *to* ***Vapp + 10 knots.***
d. *VOR/LOC/FMS course deviation exceeds one dot deflection.*
e. *Glideslope deviation exceeds one dot deflection.*
f. *Descent rate deviates ± 300 FPM from planned descent rate and is no greater than 1000 FPM, unless specifically briefed. (Example: a planned rate of descent 800 would result in a maximum rate of 1100 FPM)*
g. *The aircraft is not descending along the proper descent path or is unable to maintain obstacle clearance.*
h. *In addition to the above, after the FAF on a CAT II approach, either the PF or PM should initiate the go-around for:*
    1. *Autopilot disengagement without adequate visual reference*
    2. *A hard-over (AFM Supplement 1 S1-8)*
    3. *A slow-over (AFM Supplement 1 S1-8)*

i. In addition to the above, below 500' above minimums on a CAT II approach, either the PF or the PM should initiate the missed approach for:

1. *An amber CAT II annunciator*
2. *An amber LOC, GS, or RA annunciator*
3. *An Amber lateral deviation bar*
4. *An Amber GS pointer*

8.4 Approach Deviation Callouts

The TSA Standard Operating Procedures Manual for the EMB-145, Section 1, "Maneuvers & Procedures Guide", dated January 20, 2016 provided the following guidance:

The PM will callout aircraft deviations from the proper approach course and descent profile during any portion of a visual or instrument approach in plain language.

The PM will callout using plain language any navigational abnormalities or flight instrument malfunctions as they occur.

During the initial and intermediate segments of an instrument approach when operating between 2000' AGL and 1000' AGL, the PM will callout ***"SINK"*** *if vertical speed exceeds 2000 FPM*

Additionally, the PM will callout Airspeed, Vertical Speed, Course and GS deviations as follows while the aircraft is descending on the final approach segment:

Airspeed Deviations – The PM will callout sustained deviations ± 5 knots from the target VAPP speed. The PM will callout airspeed deviations using the call ***"SPEED"****. At approximately 100 feet above touchdown and after the landing is assured, the PM will call any speed deviation from VREF in the same manner as above.*

*Vertical Speed Deviations – The PM will callout VS deviations ± 200 FPM from the planned vertical speed for the approach. The word "****SINK****" will be called. Lateral Course Deviations - The PM will callout LOC/VOR/FMS deviations of ±1/2 of a DOT for CAT I approaches. For CAT II approaches, the PM/FO will call out LOC deviations of ±1/2 of a DOT prior to the* ***"FIVE HUNDRED ABOVE"*** *callout. After the* ***"FIVE HUNDRED ABOVE"*** *callout the PM/FO will call out deviations of ±1/4 of a DOT. The word* ***"COURSE"*** *will be called.*

ILS Glideslope Course Deviations - The PM will callout ILS GS deviations of ±1/2 DOT for CAT approaches. For CAT II approaches, the PM/FO will call out LOC deviations of ±1/2 of a DOT that occur prior to the ***"FIVE HUNDRED ABOVE"*** *callout. After the* ***"FIVE HUNDRED ABOVE"*** *callout the PM/FO will call out any deviations of ±1/4 of a DOT. The word* ***"GLIDESLOPE"*** *will be called.*

Deviations from Planned Vertical Descent Path – The PM will callout using plain language if the aircraft deviates from the planned vertical descent path and is not flying the correct descent path.

*The PF will acknowledge all approach deviations whenever they occur by stating, "**CORRECTING"** and make thrust, pitch or heading changes to correct the deviation. If the PF is unable to bring the aircraft back within acceptable stabilized approach parameters an immediate missed approach will be executed. Either pilot may initiate a missed approach by calling **"GO AROUND"**.*

8.5 Two-Engine Visual Approach

According to the Trans States EMB-145 Standard Operating Procedures Manual, Section 4.5 "Two-Engine Visual Approach and Landing" stated the following:

*A visual approach should be flown with a standard traffic pattern in accordance with the AIM or as directed by ATC. Traffic pattern entry should be made at not less than 1,500 feet AFE at a maximum airspeed of 200 kts. In icing conditions, select Flaps 9 before slowing below 200 kts. In normal conditions, Flaps 9 should be delayed until read to slow below 180-kts. Abeam the threshold, select Flaps 9, (unless already selected) Gear DOWN and slow to 160 kts. On base, select Flaps 22 and slow to 145 kts. On final, select Flaps 45. Slow to Vapp and sync the HDG bug. The PF will verify Gear DOWN and Flaps 45, and state **"I SEE GEAR DOWN, FLAPS _____ BEFORE LANDING CHECKLIST"**. The PM will complete the checklist. The aircraft will be stabilized and configured at not less than 1000 feet AFE. Appropriate callouts will be made by the PM with the PF responding with the required action and call out.*

***Note:** Airspeeds are those suggested for normal operations, and will be used during training. In day-to-day operations, at altitudes above the minimum stabilized approach height, speeds may be modified at the request of ATC.*

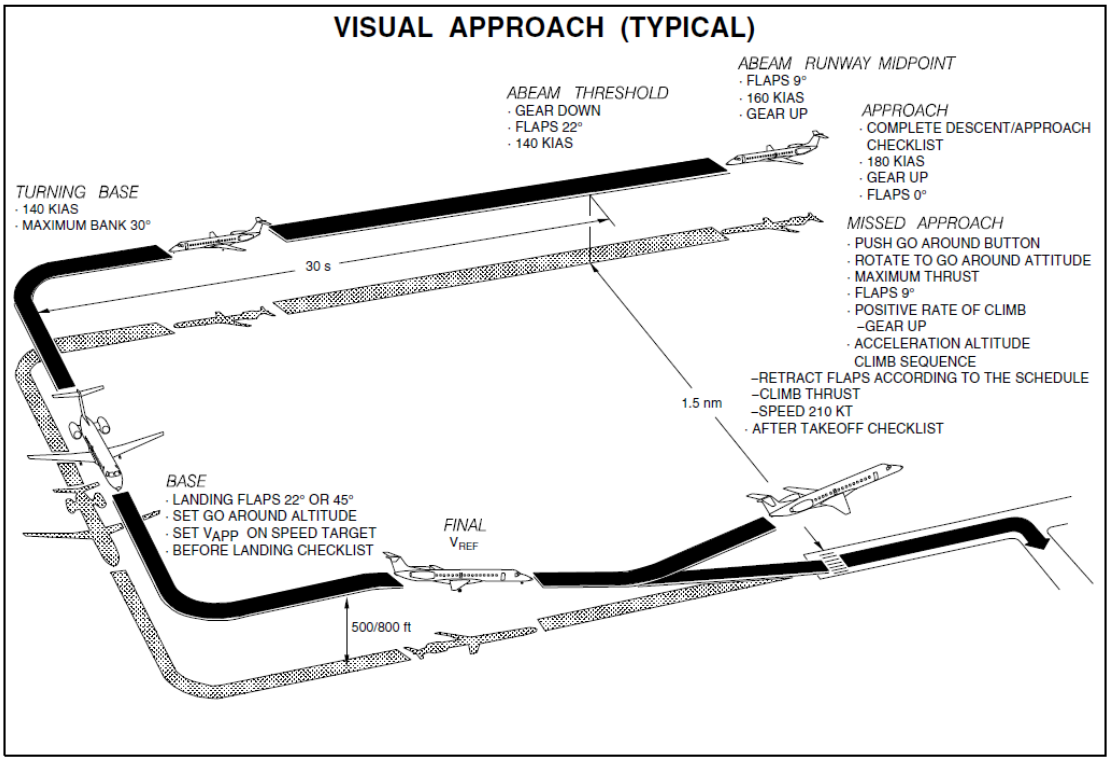


Figure 8: Visual Approach (Source: TSA EMB-145 Airplane Operations Manual – Normal Procedures)

8.6 Before Landing Checklist

The TSA Airplane Operations Manual, section "Normal Procedures" provided the following "Before Landing" procedure:

Landing Gear ..... DOWN

Command gear down and check whether the speed is within limits for landing gear extension. Also check the three green lights before this item is confirmed.

Speed Brake ..... CLOSE
Flaps ..... ___°SET

Check that the flap position is the intended one for landing.

Landing Lights ..... AS REQUIRED
Auto Pilot & Yaw Damper ..... OFF

CAUTION: YAW DAMPER ON DURING LANDING MAKES THE DIRECTIONAL CONTROLLABILITY OF THE AIRPLANE ON THE RUNWAY MORE DIFFICULT ESPECIALLY WITH GUSTS AND CROSS WINDS.

SPD Button (Flight Guidance Controller) ..... SET APPROACH CLIMB SPEED

8.7 Landings

The Trans States Standard Operating Procedures Manual, Section 4.2 "Landing" stated the following:

The key factor for a successful landing is a stabilized approach and proper thrust/flare coordination. At an average weight and VREF, the aircraft is traveling down the runway at over 150 feet per second while in the flare. Long flare times can lead to a touchdown outside the TDZ and/or subsequent hard braking. Reducing to idle before the flare will also require an increase in pitch. Too high a pitch attitude at touchdown, and the resultant low airspeed, can degrade elevator control, making it difficult to stop the descent of the nose after spoiler deployment. Flaring high and quickly reducing thrust to idle can cause the plane to settle abruptly. Do not apply stabilizer trim during the flare.

When the aircraft is approximately 200 feet above the touchdown zone, the PF should verify the Yaw Damper OFF and reduce thrust slightly to cross the runway threshold at 50 feet and VREF. The PM will call out 20 Feet Radio Altitude and at that time the PF will smoothly reduce thrust to IDLE. The touchdown should be made on the main landing gear and the nosewheel gently lowered to the runway.

The desired touchdown point is within the first 800 to 1,500 feet beyond the landing threshold. Aircraft must touch down in the first third of the available landing distance, but in no case more than 3,000 feet down the available landing distance. If this is not accomplished, a go-around must be executed.

Tail strikes may occur at pitch attitudes greater than 10 degrees, especially if flaring abruptly or excessively to "save" a nice landing. Accept a firm landing to avoid a tail strike.

During landing, when the runway threshold passes under the airplane nose and out of sight, shift the visual sighting point to approximately ¾ the runway length. Shifting the visual sighting point down the runway assists in controlling the pitch attitude during the flare. Maintain constant airspeed and descent rate. Initiate the flare when the main gear is approximately 20 feet above the runway by increasing pitch attitude approximately 2 degrees. This will slow the rate of descent. After the flare is initiated, smoothly retard the thrust levers to idle, and make small pitch attitude adjustments to maintain the desired descent rate to the runway. Ideally, main gear touchdown should occur simultaneously with thrust levers reaching idle. Hold sufficient back pressure on the control column to keep the pitch attitude constant. Do not increase pitch attitude further as floating may result causing an excessive amount of runway to be used. Also, increasing pitch attitude may cause the aft body to contact the runway. Touchdown at a speed significantly below VREF seriously reduces aft fuselage runway clearance, and can result in a tail strike.

The PM should monitor the pitch attitude during landing. If the pitch attitude approaches 10 degrees, the PM should make a call out of ***"ATTITUDE"*** *to alert the PF not to pitch up aggressively before touch down.*

8.7.1 Landing with a Crosswind

The Trans States Standard Operating Procedures Manual, Section 4.2.A "Landing with a Crosswind" stated the following:

> *If a crosswind is present, use the crab method for correction on final. Just before touchdown, a sideslip should be used to cause the upwind main wheel to touch down first. Aileron deflection should be increased as the aircraft slows. See the limitations section for maximum recommended crosswind limits.*

8.7.1.1 Crosswind Limitations

Max Recommended Crosswind (Non-AFM)	Dry Runway	30 Knots
	Wet Runway	
	Runway with Compacted Snow	25 Knots
	Runway with Standing Water or Slush	20 Knots
	Runway with Ice (no melting)	10 Knots

Figure 9: Crosswind Limitation - TSA EMB-145 Standard Operating Procedures Manual

8.8 Two-Engine Missed Approach or Rejected Landing

The Trans States Standard Operating Procedures Manual, Section 4.6 "Two-Engine Missed Approach or Rejected Landing" stated in part:

> *By definition, a missed approach and a rejected landing are two separate maneuvers. However, the procedures for execution of these two maneuvers are identical. Upon reaching the DDA, missed approach point or DA on a precision approach, if a landing cannot be accomplished the pilot must comply with the missed approach instructions for the procedure being used (or with alternate messed approach instruction given by ATC). IF for any reason an early missed approach is executed, the pilot should (unless otherwise cleared by ATC) fly the procedure as specified on the approach to the missed approach point at or above DDA, MDA or DA before executing a turning maneuver.*
>
> *The PF or the PM may initiate a go-around. The PF's immediate response to a **"GO AROUND"** callout by the PM is execution of a missed approach. When the decision is made to initiate a missed approach or rejected landing, the PF should immediately disconnect the autopilot, press the go-around button while advancing the thrust levers to the MAX THRUST position and pitch to the command bars (10° nose up).*

8.8.1 Missed Approach Procedure

The TSA EMB-145 Airplane Operations Manual, section "Normal Procedures" provided the following procedure for conducting a missed approach:

> *Go Around Button ..... PRESS*
>
> *Press the Go Around buttons at the thrust levers and check if Flight Director goes to pitch 10° nose up. Rotate or verify that autopilot rotates the airplane following the Flight Director.*

Thrust Levers ..... MAX

Advance the thrust levers to MAX position and verify the engines parameter.

Flaps ..... 9°

Select the flaps control to 9° position.

With positive rate of climb:

Landing Gear ..... UP

Select the landing gear lever to the up position.

Minimum Airspeed .....APPROACH CLIMB SPEED

Maintain the pitch as commanded by the Flight Director or pitch 10° if Go Around is being performed on raw data to maintain the airplane airspeed above the minimum airspeed (approach climb speed selected on the MFD).

Once the acceleration height is reached check that the speed is consistent with the flap retraction speed, reduces the thrust levers to Thrust Set position. Select flap controls to zero position and select Climb Mode at the Thrust Rating panel.

***NOTE: -** For coupled Go-Around the altitude loss may be 75 ft.*

- During the GO-AROUND procedure, the DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

8.9 Bounced Landing Recovery

The Trans States Standard Operating Procedures Manual, Section 4.3.A "Bounced Landing Recovery" stated the following:

When a light bounce occurs, maintain or re-establish a normal landing attitude. Increasing pitch can lead to a tail strike. Beware of the increased landing distance and use power as required to soften the second touchdown. When more severe bounce occurs, initiate a go-around – do not attempt to land. Press the go-around button and advance thrust levers to MAX. Hold the flare attitude until the engines spool up and reset stabilizer trim, then follow normal go-around procedures.

8.10 Windshear Prevention/Recovery

The TSA EMB-145 Airplane Operations Manual, Section "Supplementary Procedures Navigation" provided the following information about windshear prevention/recovery:

Aural Warning: WINDSHEAR voice message is generated if

WDSHEAR red indication is presented (GPWS warning may also be activated).

Thrust Levers..... MAX
Go-around Buttons ..... PRESS

Rotate the airplane smoothly to minimize altitude loss. Flight guidance on EADI must be followed.

NOTE: Pitch attitude may be well above normal angles.

Maintain airplane configuration. Do not change gear and flap position until terrain clearance is assured.

Additionally the following procedures was located in the Trans States EMB -145 Standard Operating Procedures Manual, Section 3 "Limitations & Memory Items":

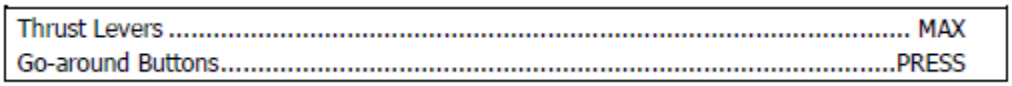


Figure 10: Windshear Prevention/Recovery Memory Item

8.11 Landing with Standard and Non-Standard Flap Settings

The Trans States Standard operating Procedures Manual, Section 4.2.C "Landing with Standard and Non-Standard Flap Settings" stated the following:

Normal landing flaps setting for CAT I[58] and visual approaches is 45 degrees.

The use of landing Flaps 22 was only authorized if one or more of the following applies:

- *CAT II[59] approach (required configuration)*
- *The wind corrected approach speed is at or above 145 KAS*
- *If directed by the QRH[60]*
- *If in the Captain's opinion the use of Flaps 22 is a safer course of action*

8.12 Safety Department Newsletter

The Trans States Safety Department published a quarterly newsletter communicating items that were brought to the safety department's attention. In October 2015, the newsletter provided the following information, in part:

Industry wide fewer than 3% of approach are unstabilized, however approximately the same percentage of unstabilized approaches result in a Go-Around…Below are some of [the] reasons why they initially chose not to Go-Around.

[58] CAT I is an instrument approach category in which the visibility and decision height are better than 1,800 feet runway visual range and 200 feet agl respectively
[59] CAT II is an instrument approach category in which the visibility and decision height are less than that of CAT I but equal to or greater than 1,200 feet and 100 feet agl, respectively
[60] Quick Reference Handbook

- *When I was an FO it always worked for me*
- *I figured it was a long runway and I would be just fine.*
- *We were almost stable.*
- *I was afraid I would mess up the Go-Around*
- *I was afraid my FO/CA would mess up the Go-Around*
- *It was VFR*
- *The airspace was crowded and I didn't want to get a TCAS RA.*

One of the philosophies behind the go-around is not that CANNOT land but rather that there is a greater risk in continuing to land- Greater than the risk in going around.

8.13 Flight Crew Operations Manual

8.13.1 No Fault Go-Around Philosophy

According to the Trans States Airlines, Flight Crew Operations Manual Section 3-5.4.1 "No Fault Go-Around Philosophy" provided the following philosophy:

The decision to execute a go around is prudent and encouraged anytime the outcome of an approach or landing is uncertain.

Plan each approach through the missed-approach procedure and make the decision to land only when all criteria are safely satisfied.

Trans States Airlines, LLC considers a go around under such condition to be an indication of good judgment and professional discipline.

8.13.2 Visual Approaches

The Trans States FCOM, Section 3-5.3 "Visual Approaches" provided the following guidance:

A. Pilots may accept visual approach clearances from ATC under the following conditions:
   1. The pilot must, at all times, have either the airport or the preceding aircraft in sight.
   2. Basic VFR weather minimums must be present (1,000' ceiling and three (3) miles visibility). In the case of a Charted Visual Flight Procedure (CVFP), the report weather must be at or above the depicted weather minimums for that CVFP.
   3. After being cleared for a visual approach, proceed to the airport in a normal manner, or as depicted in a CVFP or by following the preceding aircraft.
   4. Remain clear of clouds while conducting a visual approach.

B. Pilots must be aware of the responsibilities of accepting and flying visual approaches, particularly during marginal VMC, and must notify ATC immediately if:
   1. Unable to continue to follow the preceding aircraft

2. *Unable to remain clear of clouds*
3. *Unable to retain sight of the airport*
4. *Unable to meet the requirements of a CVFP*

C. *In Any of these cases a go-around is required and the visual approach must not be continued.*

D. *Flight crews should prepare for an instrument approach when a visual approach is planned in night VMC, or whenever IMC might be encountered.*

E. *Approach Chart Preparation should include having open and readily usable the best instrument approach chart, if one is published. A precision approach is the best selection; any other approach is the least desirable selection.*

F. *Briefing: A briefing should be conducted that includes at least the following elements:*
- *Glideslope (GS) altitude at GS intercept, or Crossing altitude at the final approach fix (FAF);*
- *VDA, descent point and planned rate of descent if CDFA;*
- *DDA, DA(H), MDA and MAP*
- *Initial heading and altitude for the missed approach procedure*
- *Charted obstacles that pose a threat to the procedure;*
- *Any NOTAMed obstacles.*

G. *Navigation Radios: Preparation should include tuning and identifying approach navaids and setting the appropriate approach course.*

Note 1: *Either the PF or the PM may make a "**GO-AROUND**" callout when it is suspected Safety of Flight may be at risk (aircraft unstabilized, aircraft on landing runway, etc.)*

Note 2: *Trans States Airlines flight operated under 14CFR 121 will not conduct visual approaches or operate VFR at airports that do not have a functioning Air Traffic Control Tower. All other visual approaches or VFR arrival and departure operations will comply with OPS SPEC C077.*

9.0 FAA Guidance

9.1 Airplane Flying Handbook

According to the Airplane Flying Handbook (FAA-H-8083, page G-2), a balked landing was synonymous with a go-around. Per the FAA Pilot/Controller Glossary, a go-around was a situation when a pilot abandons his/her approach to land. The term go-around was further explained in the FAA Airplane Flying Handbook (page 8-11) stating that a go-around may be warranted whenever landing conditions are not satisfactory, such as unmet air traffic control requirements, unexpected appearance of hazards on the runway, wind shear, wake turbulence, mechanical failure, and/or an unstabilized approach. According to the FAA, a go-around allowed a pilot to discontinue a landing approach and make another approach under more favorable conditions. A go-around was a normal maneuver which was emphasized and practiced early on in the student pilot training and is required to be demonstrated during practical tests.

9.2 Aeronautical Information Manual

According to the FAA Aeronautical Information Manual (AIM, page PCG T-4), a touchdown was the point at which an aircraft first made contact with the landing surface. The Airplane Flying Handbook (FAA-H-8083-3A), page 8-7 explained that the landing process was not over until the airplane decelerated to a normal taxi speed or comes to a complete stop. The Airplane Flying Handbook did not explicitly indicate that a go-around/balked landing could be initiated after first contact with the landing surface. However, according to the FAA, it was expected *"that a pilot may execute a balked landing/go-around if he/she determined that, after first contact with the landing surface, positive control had not been maintained or if continuing the landing process may expose the aircraft to unsafe conditions such as an unexpected appearance of hazards on the runway."*[61]

9.3 *CFR* 121.423 Pilot: Extended Envelope Training

*CFR §*121.423 stated in part:

> ***(a)*** *Each certificate holder must include in its approved training program, the extended envelope training set forth in this section with respect to each airplane type for each pilot. The extended envelope training required by this section must be performed in a Level C or higher full flight simulator, approved by the Administrator in accordance with § 121.407 of this part.*
>
> ***(b)*** *Extended envelope training must include the following maneuvers and procedures:*
>
> ***(1)*** *Manually controlled slow flight;*
>
> ***(2)*** *Manually controlled loss of reliable airspeed;*
>
> ***(3)*** *Manually controlled instrument departure and arrival;*
>
> ***(4)*** *Upset recovery maneuvers; and*
>
> ***(5)*** *Recovery from bounced landing.*

(c) *Extended envelope training must include instructor-guided hands on experience of recovery from full stall and stick pusher activation, if equipped.*

9.4 *CFR* 121 – Appendix E – Flight Training Requirements

Appendix E to *CFR*§121 provides guidance on maneuvers and procedures requirements. Section "IV. Landings and Approaches to Landings" provided the following guidance for rejected landings:

> *(g) Rejected landings that include a normal missed approach procedure after the landing is rejected. For the purpose of this maneuver the landing should be rejected at approximately 59 feet and approximately over the runway threshold."*

It further listed that it was required training for initial, transition, and upgrade training.

[61] Source: FAA Response to NTSB Information Request 13-267 dated May 2, 2013

9.5 ATC Guidance

FAA Joint Order 7110.65W "Air Traffic Organization Policy," Section 3-5-1, dated December 10, 2015, provided the following guidance:

> ***3−5−1. SELECTION***
> ***a.*** *Except where a "runway use" program is in effect, use the runway most nearly aligned with the wind when 5 knots or more or the "calm wind" runway when less than 5 knots (set tetrahedron accordingly) unless use of another runway:*
> ***NOTE−***
> ***1.*** *If a pilot prefers to use a runway different from that specified, the pilot is expected to advise ATC.*
>
> ***2.*** *At airports where a "runway use" program is established, ATC will assign runways deemed to have the least noise impact. If in the interest of safety a runway different from that specified is preferred, the pilot is expected to advise ATC accordingly. ATC will honor such requests and advise pilots when the requested runway is noise sensitive.*
>
> ***1.*** *Will be operationally advantageous, or*
> ***2.*** *Is requested by the pilot.*
>
> ***b.*** *When conducting aircraft operations on other than the advertised active runway, state the runway in use.*

Additionally, the "Pilot/Controller Glossary" ppg. PCG R-7 and PCG R-8, defined "runway use program" as:

> *RUNWAY USE PROGRAM− A noise abatement runway selection plan designed to enhance noise abatement efforts with regard to airport communities for arriving and departing aircraft. These plans are developed into runway use programs and apply to all turbojet aircraft 12,500 pounds or heavier; turbojet aircraft less than 12,500 pounds are included only if the airport proprietor determines that the aircraft creates a noise problem. Runway use programs are coordinated with FAA offices, and safety criteria used in these programs are developed by the Office of Flight Operations. Runway use programs are administered by the Air Traffic Service as "Formal" or "Informal" programs.*
>
> ***a.*** *Formal Runway Use Program− An approved noise abatement program which is defined and acknowledged in a Letter of Understanding between Flight Operations, Air Traffic Service, the airport proprietor, and the users. Once established, participation in the program is mandatory for aircraft operators and pilots as provided for in 14 CFR Section 91.129.*
>
> ***b.*** *Informal Runway Use Program− An approved noise abatement program which does not require a Letter of Understanding, and participation in the program is voluntary for aircraft operators/pilots.*

10.0 LIST OF ATTACHMENTS

Attachment 1 - Flight Crew Interview Summaries and Statements
Attachment 2 - Flight Crew Training Records
Attachment 3 – Flight Crew Schedule
Attachment 4 – Dispatch Release
Attachment 5 – STL LIDO Charts [Excerpts]
Attachment 6 – Dispatcher Statement
Attachment 7 – Accident Flight Weight and Performance Record
Attachment 8 – Trans States Standard Operations Manual [Excerpt]
Attachment 9 – Trans States Airplane Operations Manual [Excerpt]
Attachment 10 – Trans States Dispatch Operations Manual [Excerpt]

Submitted by:

_____
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